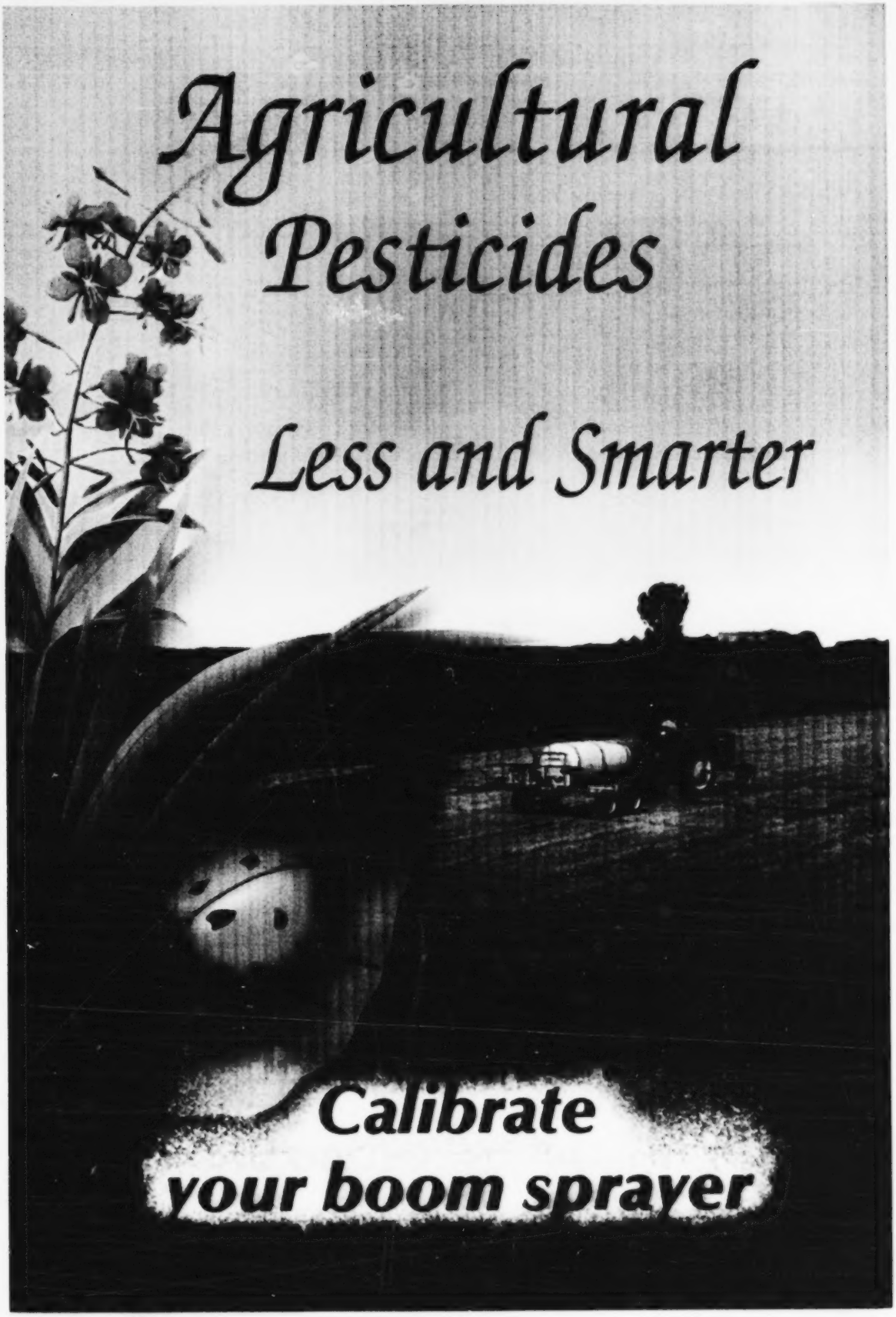
Agricultural Pesticides

Less and Smarter



Calibrate your boom sprayer

Institut de technologie agroalimentaire de La Pocatière

Québec

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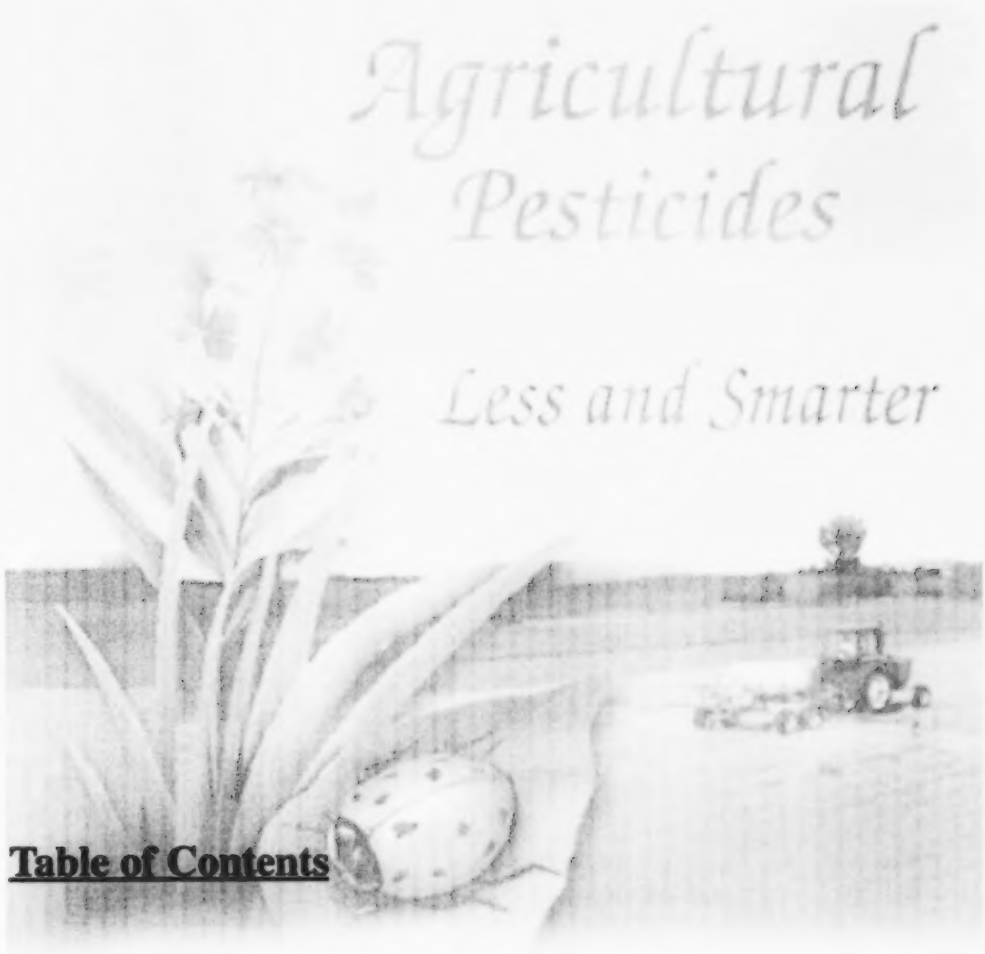

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The sprayer is a precision instrument which allows the application of products that control crop pests.

Despite its ease of use, regular checking and adjustments are necessary to ensure the quality of applications as well as the quantity applied, so that the environment is protected.

This document will provide you with procedures and tips to improve the calibration of your equipment. It will help you save time and money, while minimizing the environmental impact of applying pesticides.

Within the framework of la Stratégie phytosanitaire, the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, in partnership with the agriculture industry, launched the ACTION-RÉGLAGE project for boom sprayers in 1998.

In every region of Québec, there are accredited people with the knowledge to help you calibrate your sprayer properly. Don't hesitate to contact them.

List of accredited people
http:// www.agr.gouv.qc.ca/dgpar/agroenv/Strategie/personnes/sp05-201.html

WHAT YOU NEED IN ORDER TO CALIBRATE YOUR BOOM SPRAYER:

➢ **Check and clean the sprayer components.**

➢ **Determine :**

- Nozzle output;
- Ground speed of tractor with the boom;
- The spray width of the nozzles.

➢ **The following material :**

- Paper and pencil;
- Watch or stopwatch;
- Calculator;
- Two pickets or ground markers;
- 50 metre measuring tape;
- Tape to measure the distance between nozzles;
- Graduated containers marked off in millilitres;
- Soft brush for cleaning the nozzles.

Before beginning any work on your equipment or while handling or applying pesticides, make sure you are wearing proper protective garments.

COMPONENTS TO CHECK AND CLEAN

☑ Tank

- ☑ interior and exterior cleanliness (residue)
- ☑ leaks
- ☑ drainage valve
- ☑ intake filter
- ☑ hydraulic agitation nozzle(s)
- ☑ mechanical agitation system

☑ Pump

- ☑ lubrification
- ☑ pneumatic pressure pulsation damper (air chamber)
- ☑ Power take off (PTO) shaft

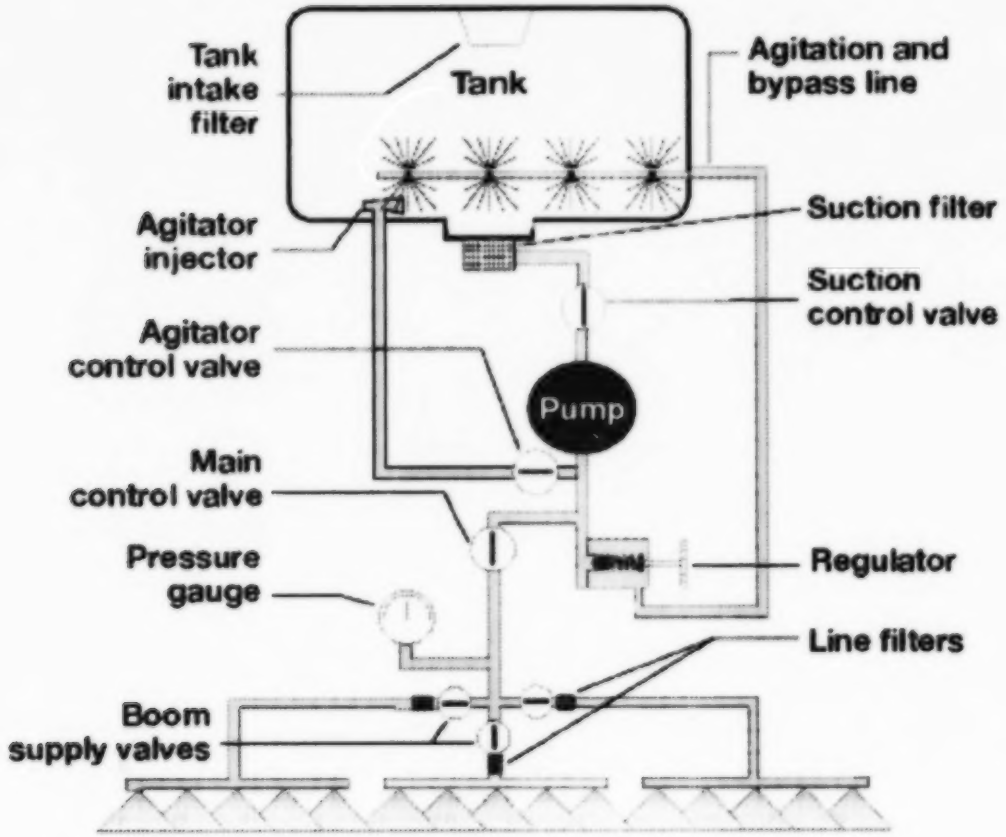
☑ Circulation system

- ☑ main filter
- ☑ line or nozzle filters
- ☑ suction and transfer hoses
- ☑ hose connectors (leaks)
- ☑ controls, cocks and valves
- ☑ pressure regulator
- ☑ bypass line (return of regulator)
- ☑ agitation line
- ☑ pressure gauge stability and accuracy

☑ Sprayer components

- ☑ nozzles (number, alignment, cleanliness)
- ☑ visual inspection of spray pattern
- ☑ boom (height, level, stability)

SUPPLYING THE BOOMS



DETERMINING THE NOZZLE SPRAY WIDTH

Measure the spacing of the nozzles (center to center) in several places, in order to calculate an average in **centimetres**. In order to obtain a **proper spray pattern**, the spacing between nozzles must be even. Spacing variations of even 5% from the average (ex: 2.5 cm for 50 cm) should be corrected on the equipment.

Average space between nozzles: L = _____ **centimetres**

DETERMINING GROUND SPEED

☑ Preparations:

1. Measure and mark off a distance of 50 metres (164 feet) on ground which is similar to the surface and soil conditions of the area to be treated;

2. Fill half the spray tank with water;

3. Check the tire pressure on the tractor and the sprayer;

4. Adjust motor speed so that the PTO revs at 540 r.p.m;

5. Select a forward gear;

6. If possible, lower the boom to check the sprayer's stability;

7. Start several metres before the first marker to stabilize motor speed before beginning the test.

☑ Calculations:

8. Get the average time, **in seconds**, it takes to travel 50 meters **(minimum of 2 tries)**.

9. Calculate the speed **(S)** using the following table or the table of results. (See annex.)

Speed based on time necessary to travel 50 meters

Sec/50 m	16	17	18	19	20	21	22	23	24	25	26	27	28
Speed in km/h	11.3	10.6	10.0	9.5	9.0	8.6	8.2	7.8	7.5	7.2	6.9	6.7	6.4
Sec/50 m	29	30	31	32	33	34	35	36	37	38	39	40	41
speed in km/h	6.2	6.0	5.8	5.6	5.5	5.3	5.1	5.0	4.9	4.7	4.6	4.5	4.4

DETERMINING AVERAGE NOZZLE OUTPUT

☑ Preparations:

1. Immobilize the equipment and adjust the motor speed to be identical to that used to determine your ground speed;
2. Open up the controls, the cocks and valves appropriate for the job to be done;
3. Adjust required pressure according to the nozzles and the type of application. Note the pressure.
   Keep in mind that:
   - Higher pressure means finer droplets and an increase in the risk of drift;
   - That pressure must be quadrupled (4X) in order to double (2X) the output of a nozzle.

☑ Measurements and calculations:

4. Using a container graduated in millilitres, collect the output of each nozzle over a 30 or 60 second period;
5. Write the results (in millilitres) for each nozzle in the test tables (see annex).
6. Calculate the initial average of the output gathered from all the nozzles.

☑ Interpretation of the results:

7. Discard result from any nozzle whose output differs by more than 10% from the average;
   - If less than 20% (ex: 6 nozzles out of 30) of the nozzles are discarded, a second average must be recalculated with the remaining nozzles;
   - If more than 20% of the nozzle outputs are discarded, the output of the boom will not be uniform. It would be best to change all the nozzles and start your volume tests again.

DETERMINING AVERAGE OUTPUT OF THE NOZZLES (continued)

8. This average will allow you to obtain the output:

   - If your tests were based on 30 second periods, multiply the average obtained by 2 and divide by 1000, **(O) in _____ liters/minute**;
   - If your tests were based on 60 second periods, divide the average obtained by 1000, **(O) in _____ liters/minute.**

PLEASE NOTE:

Before applying any pesticides, don't forget to make the corrections to the nozzles whose output was discarded in your tests (i.e.: cleaning or replacement).

9. **Checking against the manufacturer's specifications**

   If you have access to the manufacturer's charts for your type of nozzles, compare your results to the manufacturer's specifications. **This can help you discover if your nozzle tips are worn, whether the nozzles are properly angled, whether their spray pattern is standard and if the droplet size is consistent with the pressure used.**

   - If the difference between your average output and the manufacturer's output is over 10%, your nozzles may be worn. If they are new, then your pressure gauge may be indicating a pressure that is lower than the real pressure.

   - If the difference between your average output and the manufacturer's output is less than 10%, your pressure gauge may be indicating a pressure that is higher than the real pressure.

NOZZLE FLOW RATE

You can find the flow rate of your sprayer, that is the quantity of liquid applied per surface unit, by measuring the volume of liquid from one nozzle, under certain conditions.

METHOD:

1. Identify a nozzle whose output is the closest to the average output calculated for the whole group (see example on page 10);
2. Adjust the device to the same pressure as used in the tests to determine the average output;
3. Choose, from the speed test results, the speed appropriate to the type of application (taking the stability of the boom, the driving precision, etc., into account);
4. Collect the spray from the nozzle tip for the same period of time as used in the speed test;
5. Multiply the volume collected (in millilitres) by one of the following factors:

Multiplication factors to determine the rate of application (l/ha) using the volume of liquid from one nozzle (ml) gathered for a distance of 50 metres.	
Space between nozzles	**Multiplication factor**
30 cm	**0.667**
50 cm	**0.4**
20 inches (50.8 cm)	**0.394**
30 inches (76.2 cm)	**0.262**

Table of results (with the example on page 10)

Nozzle #	Gear selection	Time (s)	Volume of liquid (ml)	Multiplication factor	Rate of application (l /ha)
5	**M-2**	**33.5**	**560**	**0.394**	***220 l / ha***

MY TEST RESULTS TABLE – EXAMPLE

Nozzle test tables					
Nozzle #	**Volume** (1st avg) ***(ml)***	**Volume** (2nd avg) ***(ml)***	**Nozzle #**	**Volume** (1st avg) ***(ml)***	**Volume** (2nd avg) ***(ml)***
1	500	*500*	16	510	*510*
2	525	*525*	17	525	*525*
3	525	*525*	18	510	*510*
4	500	*500*	19	500	*500*
5	510	*510*	20	500	*500*
6	500	*500*	21		
7	450	*discarded*	22		
8	525	*525*	23		
9	525	*525*	24		
10	500	*500*	25		
11	525	*525*	26		
12	525	*525*	27		
13	500	*500*	28		
14	510	*510*	29		
15	525	*525*	30		

SEE PROCEDURE ON PAGE 7

1st Total	**10190 ml**
1st average	**510 ml**
-10% average	***460 ml***
+10% average	***560 ml***

2nd Total	**9740 ml**
2nd average	**513 ml**

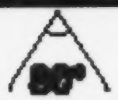
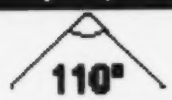
Average output table (O in liters/minute)		
Type of nozzle	**XR 8003**	
Pressure used	35 psi	
Manufacturer's output specs ***(liters/min)***	1.08	
Test time ***(seconds)***	30	
Average volume ***(milliliters)***	513	
Average output *(O – liters/min)*	**1.03**	
% variation = $\frac{(\text{O} - \text{manufacturer's output})}{\text{manufacturer's output}} \times 100$	**-4.6 %**	

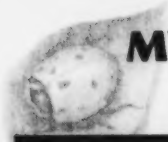
MY TEST RESULTS TABLE - EXAMPLE

Speed of advance (S in kilometers / hour)			
Tractor	M-H		
Motor speed	1950 R.P.M.		
Gear	M-2	M-3	
Average time *(seconds)*	33.5	28	
Distance *(metres)*	50	50	
Speed (S - *km/h*)	**5.4**	**6.4**	
S = 50 metres x 3.6 / time ou 180 / time			

Calculation of application rate (Q in liters/ hectare)		
Average output calculated (O- *liters/min*)	**1.03**	**1.03**
Width between nozzles (W – *centimeters*)	**50.8**	**50.8**
Speed (*S – km/hour*)	**5.4**	**6.4**
Application rate **(Q) = O x 60000 / W x S**	**225**	**190**

Calculation of the quantity of product per tank		
Dose ***(quantity of product recommended/hectare)***	**3.0 liters**	**3.0 liters**
Tank capacity in liters (C – liters)	**800**	**800**
Calculated rate of application (**Q - *liters/ha***)	**225**	**190**
Quantity/tank = **Dose** x tank capacity (**C**) / Calculated rate of application (**Q**)	**10.6 liters**	**12.6 liters**
Area covered with one tank Area (**A**) = Tank capacity (**C**) / Calculated rate of application (**Q**)	**3.5 ha**	**4.2 ha**

Boom height relative to target spray area			
			
Spacing	Height	Spacing	Height
50 cm	50 à 70 cm	50 cm	**30 à 50 cm**
75 cm	**90 à 110 cm**	75 cm	**50 à 75 cm**



MY TEST RESULTS TABLE – Chart A

ADJUSTMENT DATE:

Nozzle test tables

Nozzle #	Volume (1st avg) *(ml)*	Volume (2nd avg) *(ml)*	Nozzle #	Volume (1st avg) *(ml)*	Volume (2nd avg) *(ml)*
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

1st Total	
1st average	
-10% average	
+10% average	

2nd Total	
2e average	

Average output table (O in liters/minute)

Type of nozzle		
Pressure used		
Manufacturer's output specs ***(liters/min)***		
Test time ***(seconds)***		
Average volume ***(milliliters)***		
Average output (O - *liters/min*)		
% variation = (O - manufacturer's output) x 100 / manufacturer's output		

MY TEST RESULTS TABLE – Chart A

Speed of advance (S in kilometers / hour)			
Tractor			
Motor speed			
Gear			
Average time *(seconds)*			
Distance *(metres)*			
Speed (S - *km/h*)			
S = 50 meters x 3.6 / time ou 180 / time			

Calculation of application rate (Q in liters/ hectare)		
Average output calculated (O- *liters/min*)		
Width between nozzles (W – *centimeters*) **Speed (*S – km/hour*)**		
Application rate (Q) = **O x 60000 / W x S**		

Calculation of the quantity of product per tank		
Dose ***(quantity of product recommended/hectare)*** Tank capacity in liters (C – liters)		
Calculated rate of application (**Q - *liters/ha***)		
Quantity/tank = **Dose** x tank capacity (**C**)		
Calculated rate of application (**Q**)		
Area covered with one tank Area (**A**) = Tank capacity (**C**) / Calculated rate of application (**Q**)		

Boom height relative to target spray area			
Spacing	Height	Spacing	Height
50 cm	50 cm	50 cm	**30 à 50 cm**
75 cm	**90 à 110 cm**	75 cm	**50 à 75 cm**

MY TEST RESULTS TABLE – Chart B

ADJUSTMENT DATE:

Nozzle test tables

Nozzle #	Volume (1st avg) *(ml)*	Volume (2nd avg) *(ml)*	Nozzle #	Volume (1st avg) *(ml)*	Volume (2nd avg) *(ml)*
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

1st Total		**2nd Total**	
1st average		**2e average**	
-10% average			
+10% average			

Average output table (O in liters/minute)

Type of nozzle		
Pressure used		
Manufacturer's output specs *(liters/min)*		
Test time *(seconds)*		
Average volume *(milliliters)*		
Average output (O - *liters/min*)		
% variation = (O - manufacturer's output) x 100 / manufacturer's output		

MY TEST RESULTS TABLE – Chart B

Speed of advance (S in kilometers / hour)			
Tractor			
Motor speed			
Gear			
Average time ***(seconds)***			
Distance ***(metres)***			
Speed (S - *km/h*)			
S = 50 meters x 3.6 / time ou 180 / time			

Calculation of application rate (Q in liters/ hectare)		
Average output calculated (O- *liters/min*)		
Width between nozzles (W – *centimeters*) **Speed (*S* – *km/hour*)**		
Application rate **(Q) = O x 60000 / W x S**		

Calculation of the quantity of product per tank		
Dose ***(quantity of product recommended/hectare)***		
Tank capacity in liters (C – liters)		
Calculated rate of application (**Q - *liters/ha***)		
Quantity/tank = **Dose** x tank capacity (**C**)		
Calculated rate of application (**Q**)		
Area covered with one tank Area (**A**) = Tank capacity (**C**) / Calculated rate of application (**Q**)		

Boom height relative to target spray area			
Spacing	Height	Spacing	Height
50 cm	[illegible]	50 cm	**30 à 50 cm**
75 cm	**90 à 110 cm**	75 cm	**50 à 75 cm**

MY TEST RESULTS TABLE – Chart C

ADJUSTMENT DATE:

Nozzle test tables

Nozzle #	Volume (1st avg) *(ml)*	Volume (2nd avg) *(ml)*	Nozzle #	Volume (1st avg) *(ml)*	Volume (2nd avg) *(ml)*
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

1st Total	
1st average	
-10% average	
+10% average	

2nd Total	
2e average	

Average output table (O in liters/minute)

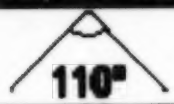
Type of nozzle		
Pressure used		
Manufacturer's output specs ***(liters/min)***		
Test time ***(seconds)***		
Average volume ***(milliliters)***		
Average output (O - *liters/min*)		
% variation = (O - manufacturer's output) x 100 / manufacturer's output		

MY TEST RESULTS TABLE – Chart C

Speed of advance (S in kilometers / hour)			
Tractor			
Motor speed			
Gear			
Average time ***(seconds)***			
Distance ***(metres)***			
Speed (S - *km/h*)			
S = 50 meters x 3.6 / time ou 180 / time			

Calculation of application rate (Q in liters/ hectare)		
Average output calculated (O- *liters/min*)		
Width between nozzles (W – *centimeters*) **Speed (*S – km/hour*)**		
Application rate **(Q) = O x 60000 / W x S**		

Calculation of the quantity of product per tank		
Dose ***(quantity of product recommended/hectare)*** Tank capacity in liters (C – liters)		
Calculated rate of application (**Q - *liters/ha***)		
Quantity/tank = **Dose** x tank capacity **(C)**		
Calculated rate of application **(Q)**		
Area covered with one tank Area **(A)** = Tank capacity **(C)** / Calculated rate of application **(Q)**		

Boom height relative to target spray area			
			
Spacing	Height	Spacing	Height
50 cm	[illegible]	50 cm	**30 à 50 cm**
75 cm	**90 à 110 cm**	75 cm	**50 à 75 cm**

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